RELATIONSHIP BETWEEN TIME AND FREQUENCY DOMAIN MEASUREMENTS OF HEART RATE VARIABILITY

Robert E. Kleiger, J. Thomas Bigger, Linda Rolnitzky, James Cook, Richard Steinman, Washington University Medical Center, St.Louis, MO

Both frequency and time domain measurements of heart rate variability (HRV) have been used to assess autonomic tone, particularly those influenced by vagal tone. Their relationships have not been well defined. We studied 14 normal subjects aged 20-55 with baseline 24 hour ambulatory ECG recording. By spectral analysis total, high, and low frequency power (TP,HF,LF) were determined. The time domain measures of cycle length variability (CLV, 24 hour standard deviation of normal RR intervals), pNN50 (proportion of adjacent normal cycle differences >50 ms), MSSD(root mean square successive differences) were also measured from the same recordings. The following table shows the correlations of these variables.

	CLV	MSSD	pNN50	TP	LF
MSSD	0.775				
pNN50	0.712	0.970			
TP	0.862	0.945	0.924		
LF	0.851	0.914	0.813	0.928	
HF	0.675	0.976	0.926	0.881	0.893

pNN50, MSSD, LF,HF and TP are all strongly correlated with each other and all predominantly reflect vagal tone. Thus the time domain measures pNN50 or MSSD may be substituted for the spectral measures. The correlation between CLV and the vagally influenced variables is weaker suggesting that CLV is more affected by non-vagal influences.

ALTERATION OF P-WAVE MORPHOLOGY AFTER VVI PACING.

Jo P. Snoeck, Hans L. Decoster, Marc M. Berkhof, Chris J. Vrints, Marc A. Verherstraeten, Xavier P. Marchand*, Jean C. Kahn*.
University Hospital Antwerp, Belgium.
* C.H.I. Poissy, France.

P-wave characteristics were serially assessed in 285 patients (mean age 78±11) during a period of 5 years after VVI-pacemaker implantation. The aim of the study was to determine any effect of VVI pacing on the P-wave morphology and its influence on the development of atrial fibrillation (AF).
Total P-wave duration measured in V1 and II increased progressively up to 5 years after implantation (p<0.001 o vs 5 years). The duration of the terminal negative force in V1 (-FV1) increased also progressively (p<0.001 o vs 5 years) while the duration of the initial positive force (+FV1) remained unchanged.

	0	1	2-5	>5 years
V1	106	121	134	144 msec.
-FV1	57	66	75	87 msec.
+FV1	49	55	59	57 msec.
II	110	124	134	138 msec.
AF	0	12.5	26	35 %

The prolongation of the P-wave was associated with an increased incidence of atrial fibrillation. Moreover identical changes were observed in patients with sick sinus and AV block indicating that this evolution is not influenced by the underlying condition.

ELECTROCARDIOGRAPHIC IDENTIFICATION OF LEFT VENTRICULAR HYPERTROPHY USING A SELF-LEARNING NEURAL NETWORK

Kenneth M. Stein MD, Thomas J. Molloy MD, Peter M. Okin MD, FACC, Richard B. Devereux MD, FACC, and Paul Kligfield MD, FACC. Cornell Medical Center, New York, NY.

Self-learning neural networks comprise a set of computer algorithms designed to learn pattern recognition through recursive instruction. We used this technique to develop a model to identify LVH based on ECG criteria in 215 adult patients who underwent autopsy. Left ventricular hypertrophy (LVH) was defined when left ventricular mass, indexed for body surface area, exceeded 118 g/m^2 for men or 104 g/m^2 for women. The first 106 patients ("training set") were used to train a back propagation neural network consisting of a 5x1 input layer, a 2x1 hidden layer, and a 1x1 output layer. The input was a normalized and scaled vector including gender, R wave amplitude in aVL, S wave amplitude in V_3, QRS duration, and positive T wave voltage in V_1. The output was designated "LVH score". The model was trained through 20,000 iterations with a noise level of 0.05 and an error tolerance of 0.1. When applied to the remaining 109 patients ("validation set") LVH score had sensitivity of 64% at specificity of 91% and sensitivity of 31% at specificity of 97%. When applied to the same validation set Cornell voltage criteria adjusted for age, gender and T wave amplitude had lower sensitivity of 42% at a specificity of 91% (p=0.02) but maintained this 42% sensitivity even at 97% specificity (p=ns). Neural network techniques may represent a useful method for improving algorithmic ECG recognition of LVH.

Tuesday, March 5, 1991
Poster Displayed: 2:00PM–5:00PM
Author Present: 2:00PM–3:00PM
Hall F, West Concourse
Efficacy in the Diagnosis of Coronary Artery Disease and Myocardial Ischemia

J POINT MEASUREMENT DEGRADES THE PERFORMANCE OF HEART RATE ADJUSTED INDICES OF ST SEGMENT DEPRESSION

Peter M. Okin MD, FACC, Geoffrey Bergman MD, Paul Kligfield MD, FACC, Cornell Medical Center, New York, NY.

Recent reports critical of the performance of heart rate adjusted indices of ST depression have used J point rather than ST segment measurements. To assess the effect of this substitution on performance of standard exercise ECG (ETT) criteria, the delta ST/HR index, and the ST/HR slope, the exercise ECGs of 50 clinically normal subjects and 80 pts with coronary disease were analyzed using ST depression measured at both the J point and at 60 ms after the J point (J+60). Sensitivities of each test were compared at matched specificities by the McNemar modification of chi-square, and areas under receiver operating characteristic (ROC) curves were used to compare overall test performance of each criteria. A positive ETT, defined as ≥0.1 mV of additional horizontal or downsloping ST depression at end exercise, had a specificity of 96% when ST depression was measured at either the J point or J+60. There was no difference in sensitivity of standard ETT criteria at J+60 and J point (both 59%, p=ns). However, at matched specificity of 96%, the delta ST/HR index and ST/HR slope calculated using ST depression at J+60 were significantly more sensitive (90% and 93%) than when calculated using J point depression (64% and 61%, each p<0.001). Comparison of areas under respective ROC curves confirmed the superior performance of J+60 as opposed to J point measurements for both the delta ST/HR index (0.98 vs 0.89, p=0.006) and the ST/HR slope (0.96 vs 0.87, p=0.007), and also demonstrated superior overall test performance for standard ETT criteria using J+60 measurements (0.88 vs 0.82, p=0.001). We conclude that use of J point measurement significantly degrades performance of heart rate adjusted indices of ST depression, but has less effect on standard criteria.